

**PHYTOTOXICOLOGY SURVEY REPORT:
SCARBOROUGH ROD AND GUN CLUB
UXBRIDGE (1992)**

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PHYTOTOXICOLOGY SURVEY REPORT:
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Phytotoxicology Survey Report: Scarborough Rod and Gun Club - Uxbridge (1992).

INTRODUCTION

In response to the request by the Ministry of Environment and Energy (MOEE) Central Region, York Durham District Office, the Phytotoxicology Section conducted a soil assessment of the Scarborough Rod and Gun Club (SRGC) property located at Lot 24 Concession 3, and adjacent residential properties in the Township of Uxbridge. The SRGC is situated on the west side of Concession Road 4, about 2 km north of Highway No. 47. The SRGC property is surrounded by mixed stands of mature trees, and is bounded on the north by the Durham Regional Forest, on the west and south by gravel pits, and on the east by residential properties. The residential properties are located about 1 km downwind from the SRGC (prevailing wind direction during the non-snow season is predominantly from the southwest). The objective of this study was to determine if lead and other metals from gun shot fallout have contaminated the soil on residential properties. Also, homeowners expressed concerns regarding children playing in (potentially lead-contaminated) soil, and the trace element content of produce from the vegetable gardens.

INVESTIGATIVE PROCEDURES

Study areas

On June 10, 1992 observations were made of the SRGC facility and adjoining areas. The SRGC occupied an area about 40 ha (100 ac). There were 6 trap houses in a north-south row and spaced about 40 meters apart. Trap house number 3 (near the centre) was located about 20 meters from the SRGC office. Next to the trap houses were broken clay pigeons (red and black in colour) and empty cartridges of various colours. Both target and skeet shooting are practiced. Soil contamination in the adjacent residential community, if present, would be close to the SRGC premises and occur only in the surface soil (top 5 - cm). This was a preliminary survey to determine if soil contamination was present. Therefore, the number of sample sites was limited, but included the SRGC property and the front yards of selected adjacent residential properties.

The residential properties were located in well-exposed, open areas, and were directly across concession Road 4 to the east of the SRGC. The locations of the soil sample sites and their spatial relationships to the SRGC property are shown in the attached sketch map.

Soil sites

A standard soil sampling procedure was used to collect the soil.⁴ Soil samples were collected at a depth of 0-5 cm in duplicate from each site. Ten sites in the vicinity of SRGC were selected for sampling. These included 6 sites on the SRGC property and 4 on neighbouring residential sites. The ten sites include:

- Site 1 - About 80 m south southeast of the SRGC office.
- Site 2 - Immediate vicinity of trap houses 3 and 4, about 20 m from the office.
- Site 3 - About 80 m north northeast of the office.
- Site 4 - About 120 m northeast of the office.
- Site 5 - About 100 m southeast of the office.
- Site 6 - About 250 m east of the office.
- Site 7 - Front yard of residential property # 5669, about 0.9 km east southeast of the office.
- Site 8 - Front yard of residential property # 5729, about 0.8 km east of the office.
- Site 9 - Front yard of residential property # 5819, about 0.8 km east northeast of the office.
- Site 10 - Front vegetable garden of residential property # 5919, about 1 km northeast of the office.

The soil sampling equipment, a chrome-plated, stainless steel corer, was cleaned between sampling sites to avoid cross-sample contamination.

Preparation of samples

All soil samples were processed in the Phytotoxicology Laboratory using standard Phytotoxicology soil processing protocols.⁵ The clay and sand content of the soil was determined by using standard field test techniques.² The pH and electrical conductivity (EC) of the soils were determined in the Phytotoxicology Laboratory. The processed samples were forwarded to the MOEE Laboratory Services Branch for analysis on a dry weight basis of the inorganic elements shown in Tables 1A and 1B using standard MOEE analytical techniques.^{6,7,8} The lead data were statistically evaluated.

RESULTS AND DISCUSSION

Soil pH and EC

The soil at all sample sites was characterized as a medium-textured sandy loam, dark in colour, with about 3 % organic matter. Results of soil pH and EC are summarized in Table 2. The EC, which is a measure of total salts, ranged from 0.25 to 0.47 millisiemens/cm. A range of 0.25 to 0.45 is suitable for most plants.³ Soil pH ranged from 7.2 to 7.5, which is normal for the soil type.

Inorganic analysis

The analytical results of the soil, and the corresponding Phytotoxicology Section "Upper Limit of Normal" (ULN) guidelines for rural surface soils in Ontario⁹ are summarized in Table 1A and 1B. The results are expressed in ug/g (micrograms per gram, commonly referred to as parts per million) and refer to the weight of chemical component per one gram of air-dried soil on a dry weight basis. The derivation and significance of the ULNs are explained in the appendix. Guideline exceedences suggest a potential source of contamination and may prompt further investigation to determine the source and significance. ULNs have not been established for phosphorous, nitrogen, magnesium, potassium, aluminum, sodium and strontium.

Lead concentrations of 185 ug/g at Site 2 and 325 ug/g at Site 4 were in excess of the ULN guideline of 150 ug/g for rural areas in Ontario. Similarly, antimony concentrations at Sites 2 and 4 (3.5 ug/g and 1.2 ug/g, respectively) exceeded the ULN guideline of 1 ug/g. However, both of these sites were on the SRGC property. None of the other soil chemical concentrations, either on the SRGC premises or on the adjacent residential properties, exceeded the ULNs. Similarly, even though there are no ULNs for nitrogen, potassium, aluminum, sodium, and strontium, concentrations of these elements were within a normal range for Ontario. Of the 20 elements, only lead had a concentration gradient relative to the SRGC. A significant correlation was found between soil lead concentrations and increasing distance from the vicinity of the SRGC office ($r = 0.41$, $p < 0.01$). A significant difference also occurred between the soil lead concentrations at the SRGC and the soil lead concentrations at the residential properties ($F = 47.95$, $p < 0.01$). The highest lead concentration (325 ug/g) was found at Site 4, about 120 meters northeast of the SRGC office. The lead concentration gradient decreased rapidly from 325 ug/g at Site 4 to a range of 10 to 23 ug/g on the neighbouring residential properties to the southeast, east and northeast. On average, soil lead concentrations were about 10 times higher on the SRGC property than the adjacent residential properties. The soil lead concentrations on the residential properties were characteristic of a rural environment.¹

CONCLUSIONS

Results of the 1992 soil survey of the SRGC property, and the residential properties down wind from the facility, indicated that lead and antimony fallout from gun shots had a measurable impact on the SRGC property. However, concentrations of the other 18 elements in soil on the SRGC property were similar to concentrations of the same elements in soil on the adjacent residential properties. The moderately-elevated lead (41 to 325 ug/g) and antimony concentrations (1.2 to 3.5 ug/g) on the SRGC property were surprisingly high considering the length of time that this facility has been in operation at this location (20 years). The lead and antimony concentrations detected on-property, such as in the immediate vicinity of the trap houses and in the target areas (Sites 2, 4 and 5), were only moderately elevated compared to other areas on the SRGC property (Sites 1, 3 and 6), and were of little environmental consequence considering the current land use.

There is no reason to restrict the use of the vegetable gardens on the residential properties based on the 1992 soil data results (range 10 to 23 ug/g lead). The residential sample sites were close to the SRGC facility, yet no off-property contamination was found.

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Table 1 A. Concentrations* of inorganic elements in soil samples collected from the Scarborough Rod and Gun club (SRGC), and adjacent residential properties, Township of Uxbridge, June, 1992.

Site No.**	Distance & direction in meters from SRGC office	Element***									
		Pb	Cu	Ni	Zn	Mn	Cd	Co	Cr	Mo	V
1	80 m SSE	41	3	6	28	275	0.3	3	9	DL	21
2	trap house	185	5	7	37	335	0.4	3	13	DL	21
3	80 m NNE	53	4	6	23	280	0.2	3	9	DL	21
4	120 m NE	325	4	7	39	395	0.4	3	10	DL	22
5	100 m SE	145	4	7	34	355	0.5	3	11	0.4	28
6	250 m E	83	4	7	35	485	0.3	4	11	DL	31
7	900 m ESE	16	5	7	40	323	0.3	3	10	0.2	24
8	800 m E	10	8	6	59	265	0.2	3	9	0.3	21
9	800 m ENE	12	5	6	34	375	0.3	3	11	DL	30
10	1000 m NE	23	6	7	48	335	0.3	4	12	DL	33
ULN		150	60	60	500	700	3.0	25	50	2	70

* = ug/g, dry weight, mean of duplicate samples and analysis.

** = Sites 1 to 6 are from the SRGC property, Sites 7 to 10 are from residential properties.

*** = Pb - lead, Cu - copper, Ni - nickel, Zn - zinc, Mn - manganese, Cd - cadmium, Co - cobalt, Cr - chromium, Mo - molybdenum, and V - vanadium.

ULN = Phytotoxicology Upper Limit of Normal guidelines (Appendix 1).

DL = At or below the detection limit (0.2 ug/g)

Values in excess of the ULN are shaded.

Table 1B. Concentrations* of inorganic elements in soil samples collected from the Scarborough Rod and Gun Club (SRGC), and adjacent residential properties, Township of Uxbridge, June, 1992.

Site No.**	Distance & direction in meters from SRGC office	Element***									
		Fe	P	N	Al	As	K	Na	Sb	Se	Sr
1	80 meters SSE	9,700	0.52	1.1	6,300	3	475	89	0.3	0.4	19
2	trap house	10,200	0.81	2.3	6,650	4	655	88	3.5	0.5	17
3	80 meters NNE	9,850	0.78	0.8	5,600	2	490	135	0.5	0.2	55
4	120 m NE	11,000	0.60	1.5	8,250	5	470	70	1.2	0.4	10
5	100 m SE	14,000	0.70	1.2	7,700	6	490	88	0.6	0.2	11
6	250 m E	15,000	0.64	1.1	7,500	3	430	85	0.4	0.8	10
7	900 m ESE	12,125	0.91	1.2	7,325	3	502	87	DL	0.7	12
8	800 m E	11,400	1.70	2.0	6,350	3	620	115	DL	0.5	39
9	800 m ENE	20,000	0.81	1.4	7,300	2	540	95	DL	1.2	14
10	1000 m NE	21,000	0.80	1.1	7,450	2	630	125	DL	0.9	13
ULN		35,000	NG	NG	NG	10	NG	NG	1	2	NG

* = ug/g, dry weight, mean of duplicate samples and analysis, except for phosphorus and nitrogen which are expressed in mg/g.

** = Sites 1 to 6 are from the SRGC property, sites 7 to 10 are from residential properties.

*** = Fe - iron, P - phosphorous, N - nitrogen, Al - aluminum, As - arsenic, K = potassium, Na = sodium, Sb = antimony, Se = selenium, and Sr = strontium.

ULN = Phytotoxicology Upper Limit of Normal guidelines (see appendix).

Values in excess of ULN are shaded

DL = At or below the detection limit (0.2 ug/g)

NG = No guideline.

Table 2. Results of pH and electrical conductivity (EC) in soil samples* collected from the Scarborough Rod and Gun Club (SRGC), and adjacent residential properties, Uxbridge, June, 1992.

Site No**	Distance & Direction in metres (m) from SRGC office	pH	EC
1	80 m SSE	7.3	0.25
2	trap house	7.3	0.25
3	80 m NNE	7.5	0.25
4	120 m NE	7.2	0.47
5	100 m SE	7.4	0.43
6	250 m E	7.5	0.42
7	900 m ESE	7.5	0.25
8	800 m E	7.5	0.27
9	800 m ENE	7.5	0.28
10	100 m NE	7.5	0.25

* = Means of duplicate samples and analysis.

** = Sites 1 to 6 are from the SRGC property, Sites 7 to 10 are from residential properties.

Appendix I

Derivation and Significance of the MOEE Phytotoxicology "Upper Limits of Normal" Contaminant Guidelines.

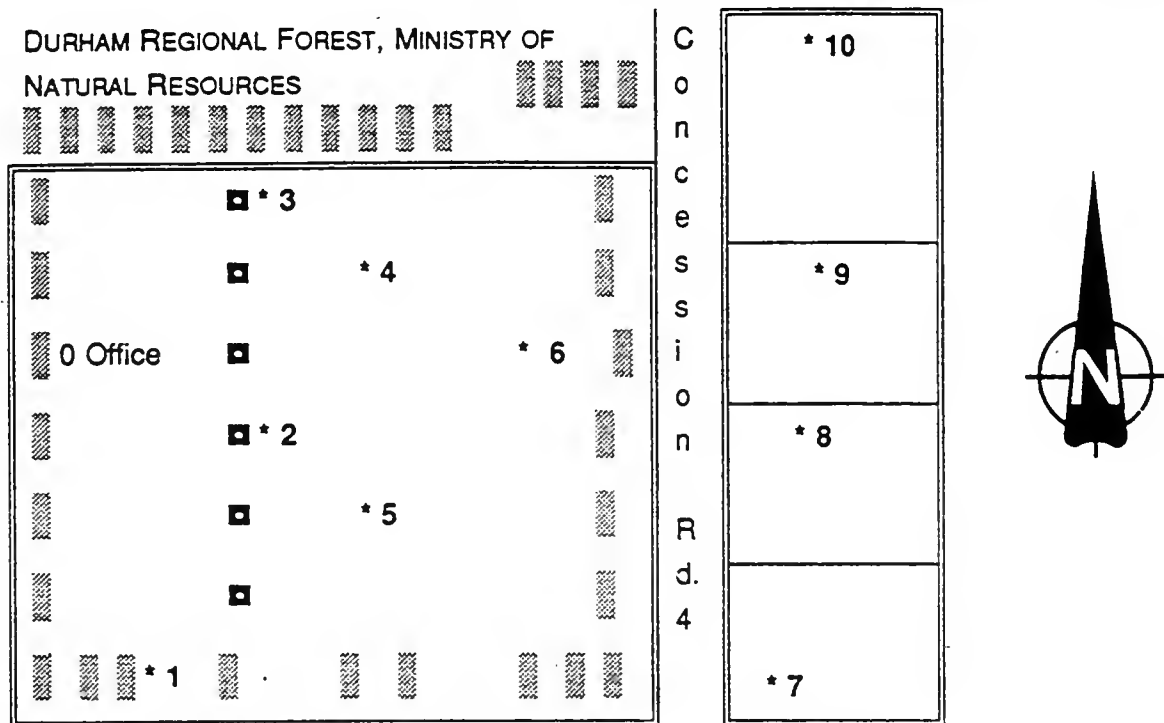
The MOEE Upper Limits of Normal (ULN) contaminant guidelines represent the expected maximum concentration in surface soil, foliage (trees and shrubs), grass, moss bags, and snow from areas in Ontario not exposed to the influence of a pollution source. Urban ULN guidelines are based on samples collected from urban centres, whereas rural ULN guidelines were developed from non-urbanized areas. Samples were collected by Phytotoxicology staff using standard sampling procedures (reference: *Ontario Ministry of the Environment. 1989. Ontario Ministry of the Environment "Upper Limit of Normal" Contaminant Guidelines for Phytotoxicology Samples. Phytotoxicology Section, Air Resources Branch: Technical Support Sections NE and NW Regions, Report No. ARB-138-88-Phyto. ISBN: 0-7729-5143-8.*). Chemical analyses were conducted by the MOEE Laboratory Services Branch.

The ULN is the arithmetic mean plus three standard deviations of the suitable background data for each chemical element and parameter. This represents 99% of the sample population. This means that for every 100 samples that have not been exposed to a pollution source, 99 will fall below the ULN.

The ULNs do not represent maximum desirable or allowable limits. Rather, they are an indication that concentrations that exceed the ULN may be the result of contamination from a pollution source. Concentrations that exceed the ULNs are not necessarily toxic to plants, animals, or people. Concentrations that are below the ULNs are not known to be toxic.

ULNs are not available for all elements. This is because some elements have a very large range in the natural environment and the ULN, calculated as the mean plus three standard deviations, would be unrealistically high. Also, for some elements, insufficient background data is available to confidently calculate ULNs. The MOEE Phytotoxicology ULNs are constantly being reviewed as the background environmental data base is expanded. This will result in more ULNs being established and may amend existing ULNs.

SKETCH MAP. Showing the Approximate Locations of the Ten Soil Sample Sites in the Vicinity of the Scarborough Rod and Gun Club, Lot 24 Concession 3, Township of Uxbridge, June, 1992. (sketch map is not to scale).



<----- Concession 3 -----> <--- Concession 4 --->

■ = Trap houses

▨ = Mixed stand of trees.

* = Sample sites: Sites 1 to 6 are on the gun club premises. Sites 7 to 10 are on residential properties, about 1 km E of the club office.

The club is bounded by gravel pits on the south and west, and by Durham Regional Forest on the north.

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